PACKAGING MACHINE AND METHOD OF FORMING AN INSERT

This is a continuation of international application No. PCT/US02/00242, filed January 3, 2002, which is hereby incorporated by reference.

This invention relates to packaging a primary article such as cans or bottles in multiple packaged cartons and is more particularly concerned with feeding inserts of such cartons in collapsed condition from a hopper, and for initiating and then completing a set of operations of inserts in sequence.

Generally, the loading placement of inserts between articles has required the downstream motion of the articles be interrupted whilst placement occurs.

US 5,862,648 to Greenwell et al discloses a machine for loading partitions between adjacent rows of bottles, each partition being guided between sets of belts. In order that the belts are aligned with the insertion points between rows of bottles, a cam mechanism moves the belts in synchronism with the direction of movement of the bottles whilst the partitions are inserted. Such a mechanism increases the complexity of the equipment and limits the throughput speeds of the articles to the cycle of the translatory motion of the discharge belts.

Furthermore, a limited number of packaging machines are capable of packaging different sizes or types of carton, for example six, eight or twelve packs of a wrap around carton. All such machines require adjustment when switching from one size or type of carton to another. This adjustment includes the manual removal of all of the cartons within the packaging machine and possibly the mechanical adjustment of components in the machine. During this change over period, which can be thirty minutes or more, a machine cannot be used (known as "down time"), which is an expensive delay in a bottling plant. Such a delay may even result in down time for the entire bottling line, not

just the packaging machine, if problems arise during the change over procedure.

It is an object of the present invention to provide a packaging machine which overcomes the technical and commercial disadvantages of known packaging machines.

It is a further object of the present invention to provide a packaging machine which is capable of switching from one carton type or size to another with a minimal down time.

One aspect of the invention provides apparatus for placing packaging material in a pre-determined position relative to an array of articles for example bottles to be packaged, comprising a conveyor for conveying an array of articles, feed means for feeding the packaging material from a direction substantially perpendicular to the direction of travel of the articles. The feed means accelerates the packaging material to a sufficient velocity relative to the velocity of the articles such that the packaging material is placed in said pre-determined position whilst continuous forward motion of the articles is maintained. In one class of embodiments, the feed means is fixed relative the article conveyor.

According to an optional feature of this aspect of the invention, synchronising means may be provided to ensure that placing of the packaging material is synchronised with the motion of the article array through the device such that placement in the pre-determined position is achieved. Preferably, the synchronising means may comprise a controller, the controller being arranged to control drive means for the feed means and/or drive means for the article conveyor.

According to another optional feature of this aspect of the invention, the feed means may comprise an endless belt having provided thereon means for engaging the packaging material. Preferably, the engaging means may comprise a lug.

According to yet another optional feature of this aspect of the invention the apparatus further comprises pick up means arranged to pick the packaging material from a conveyor up-stream thereof and to transfer it to the feed means.

The packaging material may comprise an insert to be placed between adjacent articles. Alternatively, the packaging material may be a carton to be placed around the array of articles.

A second aspect of the invention provides packaging machine comprising a packaging material feed chain comprising in series a material hopper, a feeder mechanism for transferring the articles from the hopper, apparatus for placing the packaging material in a pre-determined position relative to an array of articles for example bottles to be packaged, comprising a conveyor for conveying an array of articles, feed means for feeding the packaging material from a direction substantially perpendicular to the direction of travel of the articles, wherein the feed means accelerates the packaging material to a sufficient velocity relative to the velocity of the articles such that the packaging material is placed in said pre-determined position whilst continuous forward motion of the articles is maintained.

Preferably, there may further comprise a station for erecting the packaging material prior to transfer to the placement apparatus.

According to an optional feature of the second aspect of the invention there may further comprise a compression station for bringing the packaging material to a final position with respect to the articles.

According to another optional feature of the second aspect of the invention there may further comprise a controller comprising a central processor, manual input means, and separate means controlled by the central processor for synchronising the positioning of

the packaging material with respect to the articles. Preferably, the controller may set the relative positions of the articles and the packaging material at the in-feed end of the packaging machine.

According to another optional feature of the second aspect of the invention the controller may control a motor which drives the device for accelerating the material.

According to another optional feature of the second aspect of the invention the controller may control the motors which drive the material feed, thereby synchronising the material flow rate with the article flow rate.

A third aspect of the invention provides a method of placing packaging materials in a pre-determined position with respect to articles to be packaged comprising the steps of a) continuously feeding the articles to be packaged in a first direction; b) transferring a packaging material from an infeed to a packaging material loading station; c) accelerating the material in a direction perpendicular to the first direction to a sufficient velocity relative the articles; and d) placing the material in the pre-determined position relative the articles whilst continuous forward motion of the articles is maintained.

A fourth aspect of the invention provides a controller for controlling the operation of the insert module of a packaging machine comprising the steps of: (i) moving the packaging material by a conveyor at a first velocity from an infeed to an insert loading mechanism; (ii) setting up the packaging material; (iii) transferring the packaging material from the conveyor to the insert lugs of the insert loading mechanism by synchronising the velocity insert lugs with the first velocity of the conveyor; (iv) changing the motion of the insert to a second velocity; (v) inserting the insert into the group of articles by synchronising the position and/or velocity of the articles with the position and/or velocity of the insert.

Exemplary embodiments are now provided, by way of example only, with reference to

the accompanying drawings in which:

FIGURE 1 illustrates the blank for forming an insert that may be used with the insert placement apparatus according to one embodiment of the invention;

FIGURE 2 illustrates the insert in a set up condition formed from the blank shown in Figure 1;

FIGURE 3 is a perspective view to one side of the packaging machine incorporating insert placement apparatus of a preferred embodiment of the invention;

FIGURE 4 is a close-up perspective view from below the insert feed and set-up stations of a preferred embodiment of the invention shown in Figure 3;

FIGURE 5 is a perspective view of the insert placement station and insert compression station shown in Figures 3 and 4; and

FIGURE 6 is a flow diagram of a control system in accordance with one aspect of the invention.

Referring to the drawings and in particular Figures 1 and 2 thereof, there is shown one example of an insert 50 that may be processed by the machine of the present invention. The insert is made from paperboard, corrugated board or other suitable foldable sheet material. The insert 50 comprises a blank, having one or more medial partition panels and an end panel. There further comprises at least one transverse partition panel. Therefore, for a carton holding a group of four articles in a 2 x 2 arrangement, a single medial panel and transverse partition panel is required together with the end panel. Other arrangements are envisaged so that for three rows of articles, two medial partition panels are provided.

In the illustrated embodiment there comprises a first medial partition panel 52, an end panel 54 and second medial partition panel 56 hingedly connected together along fold lines 58 and 60 and adapted to receive twelve articles in a 3 x 4 arrangement.

Figure 1 shows one example of insert with a medial partition panel 52, provided with three transverse partition panels 62a, 62b and 62c. Each transverse partition panel is similar and therefore only partition panel 62a is described in any greater detail.

Transverse partition panel 62a is connected to medial partition panel 52 along upper and lower fold lines 66 and 68 to create a panel that extends outwardly from both sides of the medial panel 52. It will be seen from Figure 2 that, in this embodiment, fold lines 66 and 68 are aligned in a vertical plane. The upper and lower edges of panel 62a to extend one side of the medial panel are defined by cut lines which separate the panel 62a from medial panel 52. One cut line 65 extends from the lower end of fold line 66 to the upper end of the upper fold line connecting panel 62b to partition panel 52.

Similarly, the other cut line 67 extends from the upper end of fold line 68 to the lower end of the lower fold line connecting panel 62b to partition panel 52. Further cut lines 69, 71 define respectively the upper and lower edges of the part of the transverse partition panel that will extend outwardly from the other side of the medial panel 52. The opposing side edges of transverse partition panel 62a are provided by further cut lines 73.

The second medial partition panel is also provided with three transverse partition panels 64a, 64b and 64c. It will be seen that each transverse partition panel is similar and therefore only partition panel 64a is described in any greater detail.

Transverse partition panel 64a is similar to transverse partition panel 62a in that it is preferably adapted to extend outwardly on both sides of the medial panel 56. Thus, panel 64a is connected to medial partition panel 56 along fold lines 80 and 82 that are aligned

in a vertical plane. The upper and lower edges of panel 64a extend to one side of the medial panel and are defined by cut lines which separate the panel 64a from partition panel 56. A further cut line is shaped to define the part that will extend outwardly from the other side of the medial panel 56. This cut line also defines a protruding portion used to overlap the portion struck from the other medial partition panel 52. One or more alignment aperture 94 is provided. The blank is described in greater detail in co-pending application number GB 0019755.8 in the name of The Mead Corporation which is incorporated herein by reference.

Turning to the construction of the insert from the insert blank as illustrated in Figure 1, each insert requires a series of sequential folding and gluing operations which are preferably performed in a straight line machine, so that the carton and blank are not required to be rotated or inverted to complete its construction. The folding process is not limited to that described below and can be altered according to particular manufacturing requirements.

Dealing with the construction of the insert from the blank 50, shown in Figure 1, for use with the insert placement apparatus of the invention, the medial partition panel 52 is folded out of alignment from end panel 54 along fold line 58 to be placed in an overlying relationship with end panel 54 and partition panel 56. Prior to this folding operation, glue is preferably applied to the protruding portions of transverse partition panels 64a, 64b, 64c and/or 62a, 62b, 62c such that when folded, the protruding portion of 64a is secured to the protruding portion of 62a, and likewise for 64b, 62b; 64c, 62c. The insert I is supplied to the end user in this flat collapsed condition for subsequent further erection by the packaging machine as described below.

It is envisaged that the inserts will vary depending upon the shape or quantity of articles to be packaged and accordingly, the machine incorporating the present invention is adjustable in numerous respects so that it can process a wide variety of such cartons.

It is envisaged that other known types of insert I can be used, for example pre-formed inserts or divider panels used to divide one layer of articles from another, as is well known.

Turning now to the construction of the machine, the upstream end, shown in Figures 3 and 4, includes a magazine or hopper 110 in which a multiplicity of inserts 50 in a collapsed condition as described above are held for processing. The hopper may be either of the gravity feed type, or alternative means, for example a conveyor, known in the art can be used to provide a positive feed in a direction V, as shown in this embodiment.

A rotary feeder 155 is in this embodiment positioned adjacent the hopper illustrated in Figures 3 and 4 to transfer inserts 50 from the hopper to the infeed end of the machine. The feeder mechanism according to this embodiment includes a main shaft 170 rotatable in a substantially horizontal fixed axis W. The shaft 170 is generally supported at its end by a suitable bearing structure (not shown). A suitable driving mechanism such as a servomotor (not shown) is provided to rotate the shaft 170 which is controlled by the controller described below.

In order to withdraw the end collapsed insert from the hopper unit, a pick up device 168 is provided including insert engaging means, for example suction cups 180, and a frame 184 driven by the shaft about a pre-determined path. In a preferred embodiment, four pick-up devices 168 are provided on respective frames and cross bars 184.

In use, the feeder mechanism 155 continuously and sequentially feeds inserts from the hopper to the infeed end of the machine by rotating the pick-up devices 168 in the direction indicated by the arrow W, shown in Figure 3. As the pick-up device 168 rotates, suction cups 180 are moved in contact with one of the medial panels of the insert to be erected. A vacuum is then applied to the set of suction cups by a vacuum supply

(not shown), as is well known, and the insert is withdrawn and then transferred onto a conveyor to move the insert downstream in a continuous downward direction to a set-up station and thereafter onto a placement station.

The rotation of the rotary feeder 155 about a substantially horizontal axis causes the collapsed insert 50 to be translated from a substantially vertical plane in the magazine through approximately 180° to a substantially vertical plane as it is introduced into the conveyor as shown in Figure 4.

In this embodiment, the conveyor comprises a pair of conveyors 194 and 196 spaced apart such that lugs 198, 199 mounted thereon engage the end portions of the upper edge of the insert and translate the insert 50 downwardly in a direction X (Figure 3). In this embodiment, the conveyors are mounted at right angles with respect to each other so that the lugs 198, 199 are oriented to support the insert in both the transverse and longitudinal planes.

Preferably, the conveyors 194, 196 are controlled by the controller, described below, so that the timing of the inserts at the infeed can by synchronized with other parts of the machine. The conveyors 194, 196 transfer the insert to an insert construction station comprising means to erect the insert. In this embodiment the insert erecting mechanism comprises reciprocating plungers 200, 202 mounted either side of conveyors 194, 196. Of course, other known carton erecting apparatus can be used without departing from the scope of the invention, for example it is envisaged that the devices disclosed in WO 99/25546 or WO 99/1424 could be adapted to be used in this invention.

In Figures 3 and 4, plungers 200 and 202 are substantially identical and therefore only plunger 200 is described in greater detail.

As can be seen most clearly from Figure 4, plunger 200 comprises two wheels 204, 206

rotatably mounted on a housing 208 in substantially co-planar relationship. A connecting beam (not shown) or drive chain is rotatably mounted to each wheel 204, 206 at points remote from the centers of rotation thereof. A rod 210 is substantially perpendicularly mounted on the beam or drive chain and has provided at the end thereof a plate 212 to which a plurality of elongate elements or fingers 214 are secured. Drive means (not shown) such as a servomotor is provided to cause wheels 204 and 206 to rotate in unison, the arrangement of the beam and rod causing the fingers to move in a substantially circular or oval locus, whilst the axis of the fingers 214 are maintained substantially perpendicular to the plane of the insert. The velocity, acceleration and position of the fingers are controlled via the drive means by the controller, described below.

In operation, the motion of the plungers 200, 202 is synchronized with that of the inserts such that the fingers 214, 215 engage transverse panels 64a, 64b, 64c and 62a, 62b, 62c and fold the transverse panel 54 out of the plane of medial panel 56 without fouling against the apertures thereby formed in the panel. Similarly the fingers of plunger 202 are positioned in corresponding positions to engage the transverse panels 64, 62, as shown in Figure 4.

To complete erection of the insert in this embodiment, a fixed guide 216 engages transverse panel 64c and is shaped to fold it, and the remaining panels into a substantially perpendicular relationship with medial panels 56 and 58, whilst substantially causing medial panels 56 and 58 to be brought out of the mutual overlying relationship in a spaced parallel relationship as shown in Figure 2.

In more detail, to construct the individual cells C (shown in Figure 2), the transverse partition panels 62 and 64 are moved out of alignment with medial partition panels 52 and 56 respectively by fixed guide 216. Turning first to transverse partition panel 62c, the panel is caused to be folded along fold lines 66 and 68 so that the protruding portion is folded inwardly on one side of the medial panel 52. It will be seen that the transverse

partition panel 62a is caused to pivot about fold lines 66 and 68 so that the panel extends from both sides of the medial panel 52. Preferably, the transverse partition panel 62c is substantially perpendicular to the medial panel 52. Transverse partition panels 62a and 62b are formed in a like manner.

Due to the overlapping relationship and application of glue between the protruding portions of the transverse partition panels, transverse partition panels 64a, 64b, 64c are formed simultaneously in a like manner whereby panel 64c is caused to be folded out of alignment with medial panel 56 along fold lines 80 and 82 and is caused to pivot so that the transverse panel 64c extends from both sides of the medial panel 56 in a substantially perpendicular relationship with it. The use of glue or other suitable means known in the art to secure together the transverse partition panels 64c, 62c also creates a more rigid insert structure I. Panels 64b and 64a are formed in a like manner and shall therefore not be described in any greater detail. Thus, the insert is in a set up condition as shown in Figure 2. It will be seen that there are twelve cells C formed to separate and support the articles in adjacent cells.

Whilst the insert I is being erected, the downward motion continues. An insert accelerating means 220 is provided to insert the insert between the articles. In this embodiment there comprises a pair of endless belts 224a, 224b is staggered from the lower end of conveyors 194, 196 in an overlapping vertical relationship therewith. Drive means (not shown) such as a servomotor is provided to drive the belts 224a, 224b. Each belt 224a, 224b comprises one or more lugs 222a, 222b used to engage the insert at spaced positions.

In operation, the motion of the lugs 222a and 222b is synchronized with the motion of the insert 50 such that lugs 222a and 222b are brought into contact with the upper edge of medial panel 56 whilst downward motion is still controlled by lugs 198. The lugs 222a, 222b accelerate the insert to an increased velocity with respect to that of conveyors 194

and 196. In a particularly preferred embodiment, the velocity is increased to approximately five times that of conveyors 194 and 196. The drive means for driving the belt 224a, 224b is preferably controlled by the controller as described below.

At the lowest point in the working reach of the endless belts 224a and 224b, the insert is placed between an array of articles such a bottles B. In this embodiment, the bottles B are separated upstream of the machine into 4 x 3 array and are driven along lanes 242 onto an article conveyor 260 moving forward continuously in a direction Y. The bottle metering system and conveyor 260 are again driven by drive means such as servomotors such that the placement of insert 50 on the bottles is synchronized with the motion of the bottle arrays along conveyor 260 such that each bottle B is placed within one of the individual compartments C of the insert 50 as illustrated in Figure 4.

By accelerating the downward motion of the insert 50, a sufficient velocity of the insert is achieved for it to be possible for the insert to be placed between bottles B in a vertical direction only whilst the bottles maintain continuous forward of motion along conveyor 260 at normal operating speeds, without needing to be moved laterally in the direction of flow of the bottles B.

The controller (not shown) also controls the movement of the lugs 222a, 222b through the working and return reaches of the conveyor of the embodiment. The velocity of the conveyors 224a, 224b in this embodiment is synchronized with the velocity of conveyor 194, 196, for example 400 mm/sec. Once the transfer of the insert has taken place, the insert is accelerated to a velocity of say 1300 mm/sec. The conveyors 224a, 224b are maintained at this velocity to be inserted onto the necks of the articles. The cycle is completed by returning the lugs 222a, 222b to the beginning of the working reach.

In some embodiments, there comprises a sensor to detect the position of the array of articles. The controller will then adjust the velocity of the conveyors 194, 196 and/or

belts 224a, 224b so as to align the insert I with respect to the article array.

The controller through which specific instructions can be programmed and a display which indicates useful information to the machine operator. The central processor and the display can display operational information, for example, the speed of operation of the device and its compliance with particular safety requirements, in the normal manner. In addition, the central processor and display can also indicate information specific to the device, such as the position of the lugs 222a, 222b and conveyor 224a, 224b, the position of lugs 196, 198 and articles B relative to the conveyor 224 and the velocity and acceleration of the lugs 222a, 222b. The controller may also control the positions of the moveable components as well as the speed of movement of variable speed components. For example, the central processor controls one or more of the servo motors, which in turn power the feeder, the endless conveyor 194, 196 which moves inserts from the infeed end of the machine to the insert accelerating means, the plungers 200, 202, the insert accelerating means 220, the article conveyor 260 and/or the insert compression station.

Figure 6 illustrates an example of a flow diagram of a control system used to convey insert into the array of articles.

The transfer process of the insert is started (box 498). The first stage in the system is to cause the feeder to pick a carton from one of the hoppers (box 500) and to control the lugs 198, 199 (box 502) to effect transfer from the feeder to the lugs. The lugs 198,199 continue to move the insert (box 504). The position of the article array is detected (box 506) by a sensor or by determining the position via the server motor driving the lugs, as is well known. At this point, the central processor will compare the position of the array to the insert position (box 508) and will control the article feed means (box 510) and/or advance or retard the lugs 222,224 (box 512) to control the lower movement of the insert as sit is lowered onto the article array so that the insert is aligned at the point of contact P (Figure 4).

Thereafter the lugs 222 are caused by the control system to move the insert into the article array (box 514). After each of these steps has been taken, the program is restarted and the process is repeated for the next insert.

It will be understood that the positions and speeds of the devices of this embodiment of the present invention can be input manually or a specific pre-written program can be loaded into the central processor for control of the packaging machine.

Also, the control to change over the machine from one pitch to another can be accomplished through use of a pre-written program of manual input signals, for example when a different size insert is used or a different array of articles.

In order to ensure that the insert 50 is brought into the appropriate final vertical position relative to bottles B, an insert compression station 270 is preferably provided downstream of the insert accelerating means 220 as can be seen most clearly from Figure 5. In this embodiment, the compression station 270 comprises one or more compression members 278 operating in synchronism with the downstream motion of the bottles B and insert 50 in a direction Y whilst simultaneously being arranged to engage the upper edge of the insert 50 and press the insert downwardly relative to the bottles.

In a preferred embodiment, each engaging member 278 comprises a pair of mutually spaced vertically arranged flanges 280a, 280b connected via a central web portion, the lower edges of the flanges being arranged to slide between adjacent bottles and engage the upper edge of the insert. In other embodiments, it is envisaged that a number of compression members may be altered as required, or that suitable alternative arrangements for compressing the insert such as fixed guides, for example, may be employed.

In this embodiment, the above described motion is achieved by mounting the compression members 278a, 278b, 278c on a support 276 rotating about a horizontal axis by shafts 282. The support 276 is preferably driven by servomotor 272 via a gear arrangement 274. Preferably, the compression station 270 is controlled by the controller as described below to achieve synchronism with the other parts of the machine. A suitable mechanism (not shown) is provided to ensure that each engaging member is maintained in a downwardly facing position throughout the full extent of each member's contact with the insert 50. This may be achieved by any suitable means known in the art such as the use of a rotating cam arrangement.

Once an array of bottles B has passed through the compression station, it may then proceed to a carton loading station, for example or the outfeed of the machine.

According to one aspect of the invention the speed of operation of the apparatus is improved as well as its efficiency and durability. In the embodiment illustrated, the packaging speeds are around 120 packs per minute. The present invention also provides for adjustment to the size of the insert or number of articles being fed by the insert module. It is envisaged that the invention may be used in a packaging machine capable or packaging a plurality of insert sizes or types. Indeed, while the preferred embodiment described herein is for loading inserts into articles, it is recognized that the invention is not limited to inserts of this type.

The invention may be sold as part of a packaging machine or separately as a module to be fitted to a new machine or on a retrofit basis.

What is claimed is: